Sonchus megalocarpus (Dune Thistle) Compositae

This thistle is sparsely distributed through the mobile dune, usually in the shelter of mat shrubs. It differs from the common Sow Thistle, *Sonchus oleraceus* mainly in its perennial habit and coarser foliage. The tuberous root-stem stock proliferates new shoots each season.

Leaves stiff and leathery, more or less pinnatifid, with rounded, prickly-toothed lobes, the leaf bases clasping the stem with two rounded lobes. Flower heads in irregular corymbs, an involucre of bracts about 2 cm. long surrounding the numerous, yellow, ligulate flowers. Flowers: Spring and Summer. Fruits ovate-oblong, about 7 mm. by 3 mm. winged along the edges, smooth, surmounted by a pappus of fine white hairs.

This species is thought to be endemic in Australia and Tasmania, whereas *S. oleraceus* is cosmopolitan.

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A NEW SPECIES OF FROG OF THE GENUS *CRINIA*

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1. INTRODUCTION

Moore (1954) using genetical isolation as a criterion for biological species, demonstrated the presence of a sibling (or morphologically indistinguishable) species of the genus *Crinia* Tschudi in Western Australia, namely *C. insignifera* Moore. This species had previously been included with *C. signifera* Girard as one morphological species, the latter species now being restricted to eastern Australia.

Main (1957) confirmed Moore's findings and showed that actually *three* sibling species rather than one had been included with *C. signifera,* on the basis of genetical isolation as indicated by *in vitro* crosses. The taxonomical position was then shown as two eastern species: *C. signifera* and *C. parinsignifera* Main; and two western species: *C. insignifera* and *C. pseudinsignifera* Main.

Morphologically distinct and sibling species of *Crinia* known from Western Australia could readily be identified in the field by the distinctness of the male breeding call; which has been considered to have an important function in maintaining reproductive isolation between species of frogs breeding together.

In the course of an investigation into distinctness and variation of male breeding call in *Crinia* a new population possessing a distinctive and previously unrecorded call was found at Wilgarup, 7 miles north of Manjimup. This new call-type population was subsequently found at numerous locations to the east of Wilgarup.

2. MORPHOLOGICAL RELATIONSHIPS

This new species cannot be distinguished on external morphology from two apparently closely related western species, *C. insignifera* and *C. pseudinsignifera,* which are considered by Main (1957) to be siblings. Measurements of snout-vent lengths have been made with vernier calipers for mature males of *C. insignifera* and *C. pseudinsignifera* by Main (1957) and for the new species by the author. No significant differences have been found.

3. CALL STRUCTURE AND ANALYSIS

In structure the male breeding call of the new species shows closest resemblance to that of *C. insignifera,* but is of longer duration and lower modulation frequency. Both calls may be described as "squelches." The call of *C. pseudinsignifera* has similar characteristics to those of *C. insignifera,* over which is superimposed a secondary four pulsed modulation. This call may best be described as a "bleet," and as it is quite distinct from the other two, no detailed analysis is included.

Samples of calls, obtained in the field using a portable tape recorder, were analysed on a cathode ray oscilloscope, and the resulting traces photographed. Measurements of call duration and modulation frequency (i.e., pulses per second) were then determined from the photographed traces. Call repetition rate was determined by measuring, with a stopwatch, the time taken for an individual frog to make 10 successive calls.

Measurements for two analysed samples of calls, one for the new species from Wilgarup, the other for *C. insignifera* from Caversham, 9 miles north-east of Perth, are given in the table at the end of the paper.

Samples for each species recorded at different temperatures in other locations, when analysed, showed that the distinctness was maintained.

The calls are quite distinct to the ear, and the samples measured can be taken as representative of each species. The clay and coastal "races" of *C. insignifera* discussed by Main (1957) may represent extreme variants of call. Samples of calls recorded from clay and sandy areas, when analysed, show no marked differentiation; particularly when compared with calls of the new species. A

detailed consideration of these "races" will be presented in a later publication.

4. DISTRIBUTION AND HABITAT

The distribution of *C. pseudinsignifera* is extensive and allopatric to *C. insignifera* with which it becomes contiguous along the Darling Scarp. It generally breeds in any temporary ponds throughout this range. *C. insignifera* breeds in the summer dry sand and clay swamps of the Swan Coastal Plain, from Caro Swamp, 90 miles north of Perth, to Dunsborough, 166 miles south of Perth. The eastern and southern limits appear to be determined by the Darling and Whicher Scarps respectively.

The new species breeds in the sandy swamps which are dry in summer. These swamps border the main road to Pemberton, from Wilgarup to Manjimup and extending east. Its entire geographical range appears to be included within that of *C. pseudinsignifera*. The western limit of range of the new species is at Wilgarup, for although numerous traverses were made to the north, west and south-west, no extensions of range were discovered. Wilgarup is approximately 50 miles south-east of the most south-eastern limit of range for *C. insignifera*, namely 11 miles east of Busselton. The area between these locations is of hilly topography, and generally covered with prime jarrah forest. No suitable breeding sites were seen during the traverses of this region.

Extensive sandy swamps occur for some 70 miles near the southern coast from Windy Harbour to Augusta. This region is subjected to an annual rainfall of 40-50 in. Of the three species only *C. pseudinsignifera* has been heard calling. The absence of the two other populations may be attributed to some factor associated with the permanent nature of the swamps.

5. INTERFERTILITY

To further substantiate the status of this new species four controlled *in vitro* crosses were made using the technique of Rugh (1948).

(A) Three crosses:—♀ *C. insignifera* × ♂ new species, Wilgarup; with controls ♀ *C. insignifera*, Guildford × ♂ *C. insignifera*, Guildford, gave the following percentage survival of larvae to hatching. Initial egg numbers are given in parenthesis. 1. 61% (46) experimental; 84% (32) control. 2. 68% (41) exp.; 89% (44) control. 3. 29% (28) exp.; 96% (23) control. These results indicate consistent reduced larval viability between *C. insignifera* and the new species.

(B) One cross:—♀ *C. pseudinsignifera*, Cape Riche × ♂ new species, Wilgarup; gave a survival to hatch of 92% from 95 eggs. The control cross, ♀ × ♂ *C. pseudinsignifera* Cape Riche gave a survival to hatch of 96% from 100 eggs.

In the light of this latter result it is of interest to note that Moore (1955) in his review of artificial hybridisation in Amphibia has described how morphologically distinct species, when crossed,

may produce apparently normal larvae at hatching. However, the hybrids of many of these crosses fail to reach metamorphosis, and when examined cytologically are often found to be gynogenetic haploids (i.e., sperm penetration has initiated cell division but there is no contribution of chromosome material to the egg). This may be the case in the *C. pseudinsignifera* cross, but cytological evidence is not at present available.

Since these two populations occur sympatrically without call intergrades they may be presumed to be valid species.

6. BREEDING BEHAVIOUR

a. Calling Season

Choruses of *C. insignifera* are generally heard from late May through to September; while those of *C. pseudinsignifera* from the area of overlap with the new species may commence 2-3 weeks earlier, but become reduced in volume by early August. Choruses of the new species do not develop until late July and persist until early September. There is considerable overlap of calling season in all three species, but least between the new species and *C. pseudinsignifera.*

b. Calling Position

Males of the new species call when floating in deep water towards the centre of ponds. Those of *C. insignifera,* while often found in this position, may also call in the shallower water at the edges of the breeding sites. *C. pseudinsignifera* males are generally found calling in shallow water at the edges of ponds, particularly when calling males of the new species are present. In this situation some segregation is evident, and this may act as a partial isolating mechanism.

c. Calling Temperature

Since males of all three species call while partially immersed in water they are likely to be influenced by water rather than air temperature. Water temperatures when calls were heard ranged from 7.5 to 16.25° C. for *C. insignifera,* 7.0 to 21.0° C. for *C. pseudinsignifera,* and 7.0 to 13.5° C. for the new species. Thus there are broad and overlapping ranges.

Oviposition may occur over more restricted ranges but sufficient data on this point are at present lacking.

7. DISCUSSION AND DESCRIPTION

The population discussed exhibits the following characteries:—(1) The possession of a distinct and constant male breeding call. (2) The indications of inviability with *C. insignifera* by *in vitro* crosses. (3) The absence of intergrade in call or geographic range with *C. insignifera.* (4) The distinctness of call, absence of intergrade, and sympatry with *C. pseudinsignifera.*

These features taken together indicate a population which deserves status as a full species, which may be designated as follows:—

Crinia subinsignifera sp. nov.

Description: Sibling with *Crinia insignifera* and *Crinia pseudinsignifera;* cannot be distinguished from Parker's (1941) description of *Crinia signifera signifera.*

Body Lengths: Samples of specimens (all breeding) from three localities gave the following mean snout-vent measurements:—

Wilgarup	♂♂	15.8 mm. (± 0.8 S.D.)	14 specimens
Wilgarup	♀	16.9 mm. ———	1 specimen
15 miles north of Mt. Barker Warriups Rd..	♂♂	17.3 mm. (± 1.3 S.D.)	8 specimens
4 miles east of Cheyne Beach turn-off	♂♂	18.8 mm. (± 0.8 S.D.)	12 specimens

Inviability: *In vitro* crosses ♀ *insignifera* × ♂ *subinsignifera* show reduced larval viability.

Diagnosis: The new species, like its closest local relatives, *C. insignifera* and *C. pseudinsignifera,* cannot be physically distinguished, on present knowledge, from *C. signifera.* Its diagnosis depends entirely on call characteristics. The call is a long low-pitched "squeleh" of 0.71 seconds' mean duration and 140 cycles per second modulation frequency, repeated slowly and regularly. The call of *C. insignifera,* as typified by the Caversham sample, is a shorter higher-pitched "squeleh" of 0.25 seconds' mean duration and 240 cycles per second mean modulating frequency, repeated rapidly. The call of *C. pseudinsignifera* is a short four-pulsed "bleet," showing strong secondary modulation, and repeated rapidly.

Type locality: Swamps by the 181 mile peg on the main Perth to Pemberton road at Wilgarup, 7 miles north of Manjimup.

Range and habitat: Generally east of Wilgarup and Manjimup; north of the prime karri forest zone and prime jarrah forest zone, in a narrow band broadening to the south-east; to Lake Matilda; through the Vale of Kalgan; south of the Stirling Ranges to the Green Range; then south to the coast. Confined to the sandy swamps of this region which are dry in summer.

Type: No. 367/56 in the collection at the Zoology Department, University of Western Australia (to be transferred to the Western Australian Museum). Tape recording and photographs of oscilloscope traces of typical calls of *C. insignifera, C. pseudinsignifera* and *C. subinsignifera* will be lodged with the type material.

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TABLE 1.—ANALYSIS OF CALL SAMPLES

Call Characteristics	Location	C. subinsignifera Wilgarup	C. insignifera Caversham
	Water Temperature	7.0° C.	13.0° C.
Call Duration (in seconds)	No. of Individuals	11	25
	Range	0.59-0.81	0.18-0.29
	Mean	0.71	0.25
	Standard Deviation	0.07	0.03
	Standard Error of Mean	0.02	0.01
Call Modulation Frequency (in cycles per second)	No. of Individuals	11	25
	Range	106-173	164-311
	Mean	140	240
	Standard Deviation	23	30
	Standard Error of Mean	7	6
Call Repetition Rate (Time in seconds for ten successive calls to be made)	No. of Individuals	7	28
	Range	38.4-53.2	7.5-12.4
	Mean	47.1	10.1
	Standard Deviation	5.5	1.1
	Standard Error of Mean	2.1	0.2

A NEW BURROWING FROG FROM WESTERN AUSTRALIA

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Field collections from the Wheatbelt and inner pastoral areas have yielded a number of specimens of an undescribed species of frog belonging to the genus *Neobatrachus* Peters, a genus now revived to include species related to *N. pictus* Peters which have hitherto been included within the genus *Heleioporus* Gray.

Calling males of the new species were found with *N. centralis* (Parker), *N. wilsmorei* (Parker) and *N. pelobatoides* (Werner) at Morawa in 1953. A breeding congress of the new species and *centralis* was observed at Queen Victoria Spring in January 1955 (Slater and Lindgren, *W. Austr. Nat.*, 5 : 17). Breeding congresses have also been observed at Ebano Creek (Mingenew/Morawa Road) and at Gnoolowa Hill (18 miles north of Mingenew). Specimens have also been collected from a number of localities in the Wheatbelt. Where the new form occurs sympatrically with other species of the genus mating is exclusively intra-specific; no inter-specific clasping or morphological intergrades have been seen. It is therefore concluded that the new form represents a distinct biological entity which should be recognised as a valid taxonomic species and is described below as